Prosocial and positive health behaviors during a period of chronic stress protect socioemotional well-being

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Abstract

Behavior that helps, supports, or protects others—or prosocial behavior—has emerged as a health-relevant behavior that can promote the giver's well-being. Yet whether prosocial behavior protects against the effects of a major, ongoing chronic stressor warrants further examination. Thus, in the context of the 2020 COVID-19 pandemic, we examined whether two types of behaviors—those enacted to prevent the spread of disease to the self and others (positive health behaviors) and those enacted to promote others' psychological and financial well-being (prosocial behaviors)—might protect well-being over time. Using a longitudinal survey method, 745 participants (M_{age}=62.87 years) reported their engagement in positive health behaviors, prosocial behaviors, and socioemotional well-being (depressive symptoms, anxiety symptoms, loneliness) approximately two months into mandated lockdown orders in the United States. Three months later, participants again reported their well-being. Results showed that greater self-reported positive health behaviors (e.g., wearing a facemask, distancing from others) was related to decreased depressive symptoms over time, whereas greater self-reported prosocial behaviors (e.g., donating time or money, thanking an essential worker) was related to decreased loneliness over time. Neither behavior was related to anxiety symptoms. Together, results suggest that both doing things for the benefit of others and engaging in positive health behaviors protects well-being, even during times of chronic stress. Findings are however limited by the use of self-report measures. Future research should use experimental and behavioral approaches beyond self-report to verify findings.

Key words: giving support; gratitude; volunteering; COVID-19 pandemic; loneliness; chronic stress

Prosocial behavior, defined as actions intended to benefit others or society as a whole, has emerged as health-promoting (Brown & Brown, 2015; Inagaki, 2018). Giving support to close others, volunteering, or even engaging in small acts of kindness such as making breakfast or buying coffee for someone, can lead to benefits for the giver such as greater feelings of social connection, happiness, and psychological flourishing (reviewed in Hui, Ng, Berzaghi, Cunningham-Amos, & Kogan, 2020). Collectively, these results suggest that one nonintuitive route to maintaining one's socioemotional well-being is to act prosocially, behaving in ways that focus on others (e.g., Dunn, Aknin, & Norton, 2008; Nelson, Layous, Cole & Lyubomirsky, 2016). But is prosocial behavior always beneficial for well-being? To date, it remains unclear whether prosocial behavior can guard against the negative effects of chronic psychological stress (i.e., prolonged periods of uncontrollability and uncertainty) such as depressive symptoms, anxiety symptoms or loneliness (Cohen, Gianaros, & Manuck, 2016). Therefore, the current longitudinal study assessed two types of behavior that may help others and examined changes in socioemotional well-being over a three-month period during a widespread chronic psychological stressor, the 2020 coronavirus (COVID-19) pandemic.

There are good theoretical reasons to expect prosocial behavior to protect socioemotional well-being against chronic stress. Theories based on research conducted with nonhuman animals propose that the pathways supporting prosocial behavior stem in part from neurobiological mechanisms that support offspring care, wherein a caregiver dampens their own stress in order to approach and give care (Brown & Brown, 2015; Inagaki, 2018; Preston, 2013). For example, lesions to the brain regions related to the stress of witnessing others in need increase parental care in animals (e.g., Fleming, Vaccarino, & Luebke, 1980; Stack, Balakrishnan, Numan, & Numan, 2002). This suggests that the ability to dampen one's own stress response facilitates caring for others. A similar mechanism may be engaged when acting prosocially toward those other than offspring, ranging from close others to strangers to abstract causes. Consistent with this hypothesis, previous experimental work shows that prosocial

behavior buffers the negative impact of acute stressors (e.g., Inagaki & Eisenberger, 2016; Moieni et al., 2019; Wang, Ge, Zhang, Wang, & Xie, 2020). Less research, however, examines whether prosocial behavior protects socioemotional well-being in the face of a chronic psychological stressor, and whether such effects persist over time.

A related question is whether prosocial behavior needs to be solely other-focused in order to accrue benefits. Unlike altruistic behavior (behavior that benefits another at a cost to the self; Preston, 2013) and purely selfish behavior (behavior that only benefits the self), prosocial behavior may contain a mix of self and other focus while still protecting one's own well-being. Positive health behaviors, such as those recommended to curb the spread of COVID-19, may be one such set of behaviors. In the United States, behaviors such as wearing a facemask or maintaining a physical distance between persons, were framed as behaviors that protect both the self and others (CDC, 2020). Indeed, individuals can engage in positive health behaviors for both self (e.g., to minimize chronic disease risk) and other-protective reasons (e.g., to remain healthy for a child or partner; Brosso, Sheeran, Lazard, & Muscatell, 2021; Umberson, Crosnoe, & Recsek, 2010). Engaging in positive health behavior also reduces stress (e.g., Creswell & Lindsay, 2014). Whether positive health behavior enacted in response to the COVID-19 pandemic relates to better socioemotional well-being over time has not been examined yet.

With a global chronic stressor as a backdrop, the current longitudinal survey study investigated the impacts of two classes of pandemic-related behavior on socioemotional well-being (depressive symptoms, anxiety symptoms, loneliness) over a three-month period. The two sets of behavior were: those intended to protect the physical health of the self and others (i.e., positive health behavior) and those intended to promote the psychological and financial well-being of the broader community (i.e., prosocial behavior). Following the literature on prosocial and positive health behavior on well-being, we expected greater engagement in these behaviors to protect socioemotional well-being amidst the pandemic over time.

Method

Participants

Participants were recruited via a Qualtrics Panel with a study described as “A two-part study that assesses your behaviors and feelings as well as your health”. Inclusion criteria were age 18 or over, current residency in the United States, no chronic physical or mental health conditions (at Time 1 only), and no COVID-19 diagnosis or living with someone with a COVID-19 diagnosis (at Time 1 or Time 2). COVID-19 diagnoses would mean that a participant should be quarantining in isolation which could have affected the positive health behaviors, prosocial behaviors, and socioemotional wellbeing measures collected in the current study. We also sought equal representation of males and females. Qualtrics gave potential participants access to the survey based on the first two inclusion criteria (age and US residency) while ensuring equal access to male and female participants. Assessment of the additional inclusion criteria (i.e., no chronic physical or mental health issues; COVID-19 diagnosis) took place within the survey itself; data from participants who endorsed chronic physical or mental health issues at Time 1, or a COVID-19 diagnosis at Time 1 or Time 2, were excluded from analysis (see below for further detail). Qualtrics staff performed an initial data quality check prior to issuing payment. Specifically, participants had to pass an attention check for data to be included (i.e., recalling and reporting the color green). Procedures were run in accordance with the University of Pittsburgh’s Institutional Review Board and all participants provided electronic consent prior to survey completion. Participants were compensated with $8, or an $8 equivalent in rewards or points, depending upon their preference.

Sample size was determined *a priori* by a power analysis in G*Power (Erdfelder, Faul, & Buchner, 1996). At an alpha of .05, two-tailed, a sample of 700 participants was deemed sufficient to detect a small effect (Cohen’s *d* between .10 and .20) with 80% power. Qualtrics guaranteed 30% of the Time 1 sample would respond at Time 2. Therefore, recruitment staff recommended oversampling at Time 1 (minimum $N = 2700$) given the delay between the two

time points and the additional screening implemented within the survey (e.g., no COVID-19 diagnosis, no physical health conditions). The recruitment approach to Time 2 data collection, as specified by Qualtrics, was to open the Time 2 survey and notify Time 1 participants that they could complete the second survey, and to close the survey once the target *N* of 700 with complete, high-quality responses was reached (i.e., rather than the more standard approach of leaving the Time 2 survey open until a specified date and obtaining as many responses as possible). The Time 2 survey was, therefore, made available for a brief window of time and closed once the target sample had been reached (i.e., ~48-hours). Those who completed Time 1 and 2 surveys reported significantly less prosocial behavior, and lower levels of depressive symptoms, anxiety symptoms, and loneliness, than those who only completed Time 1. For additional information about participants who completed both time points vs. those who completed Time 1 only, see Supplemental Material (Table S1).

Responses from 2708 participants were collected at Time 1 and 814 of these participants also completed the Time 2 survey. Two-hundred and eleven participants screened out of the study at Time 1 for endorsing a mental health condition, 35 screened out for a current COVID-19 diagnosis (*n* = 30 at Time 1, *n* = 5 at Time 2), and 31 screened out for living with someone with a COVID-19 diagnosis (*n* = 19 at Time 1, n = 12 at Time 2). The final analytic sample, therefore, included 745 individuals (M_{age} = 62.87, SD_{age} = 12.33, range = 21 – 91 years; 51.0% female; 9.9% Hispanic/Latino; 1.1% American Indian or Alaska Native, 20.1% Asian/Asian American, 11.9% Black/African American, 0.4% Native Hawaiian/Other Pacific Islander, 59.3% White, 6.7% Other/Mixed Race, 0.4% did not report; annual household income: 6% less than $20,000, 8.9% $20,000 to $34,999, 10.1% $35,000 to $49,999, 19.7% $50,000 to $74,999, 20.0% $75,000 to $99,999, 35.3% Over $100,000). We note the final sample size is above the predetermined cutoff of 700.

Overview

Data collection for Time 1 took place from May 16-20, 2020, ending once the target sample size had been reached (i.e., a sample who had passed attention checks). Approximately three months later (August 20-21, 2020), participants from Time 1 reported again on their socioemotional well-being (Time 2). Data analyses commenced after both waves of data had been collected.

Behaviors at Time 1

Behaviors were chosen based on existing recommendations from the U.S. Center for Disease Control and Prevention (CDC, 2020) to prevent the spread of the coronavirus, as well as the current prosocial behavior literature (e.g., Brown, Brown, House, & Smith, 2008; Dunn et al., 2008; Nelson et al., 2016; Schreier et al., 2013; Telzer, Fuligni, Lieberman, & Galvan, 2014), media reports of prosocial behavior that citizens could engage in, and known opportunities to act prosocially while under lockdown. Behaviors were then organized into two categories and assessed separately. Positive health behaviors were those intended to guard against the spread of infection (i.e., described by the CDC as behaviors that “protect yourself and others”) included (1) engaging in social distancing (making an effort to remain at least 6 feet away from others) when outside of the house, (2) increasing hand washing, (3) wearing a facemask when leaving the house, (4) refraining from shaking hands with those outside of the home, and (5) staying home except for essential trips to the grocery store and pharmacy. Prosocial behaviors were those explicitly intended to promote the psychological and financial well-being of others included (1) thanking an essential worker, (2) supporting a local business that may have been affected by the coronavirus, (3) donating money or other supplies to a cause related to the coronavirus (e.g., a food bank, local hospital), (4) volunteering to buy or deliver groceries/food to someone, and (5) volunteering to buy or deliver items from the pharmacy to someone. We intentionally did not ask about behaviors that may have indicated a break in lockdown orders (e.g., visiting family) so as not to encourage such behavior. For all behaviors, participants were asked the

extent to which they engaged in the behavior since the pandemic began (1 – “not at all” to 9 – “very much” – scale). Evaluating the range of reporting for each individual behavior, participants reported across the full range of the scale (i.e., 1-9). For additional measures about each reported behavior (i.e., perceived effectiveness), see Supplemental Material.

Socioemotional Well-Being at Time 1 and 2

At both Time 1 and Time 2, participants thought back over the past two weeks and reported on their socioemotional well-being. Socioemotional well-being outcomes were selected based on their relation to both chronic stress and prosocial behavior (Cohen et al., 2016; Hui et al., 2020). Thus, depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977), anxiety symptoms were assessed with the State Anxiety Inventory (STAI; Spielberger, 1983), and loneliness was assessed with the UCLA Loneliness Scale (Russell, 1996).

Data Analysis Approach

Measurement Models. Given that we *a priori* expected and selected behaviors to split into two separate but perhaps related groups of behaviors (positive health vs. prosocial), we used latent variable structural equation modeling to conduct Confirmatory Factor Analyses (CFAs). We fit the two latent factors of interest simultaneously, with the goal of establishing whether the measurement structure of behaviors best fit two independent latent variables, two related (covarying) but different latent variables, or a single latent variable. Specifically, the manifest indicators reflecting positive health behaviors were: social distancing, hand-washing, wearing a face mask, avoiding handshakes, and staying home. The manifest indicators reflecting prosocial behaviors were: thanking essential workers, supporting local businesses, donating money or supplies, volunteering to help with food needs, or volunteering to help with pharmacy needs.

Models were fit in R using lavaan (Rosseel, 2012). Any missing data were estimated using full information maximum likelihood (Enders & Bandalos, 2001). Model fit was assessed

using the chi-square statistic (χ^2), root mean squared error of approximation (RMSEA), comparative fit index (CFI) and the Tucker Lewis index (TLI). Good model fit is typically represented by non-significant χ^2, RMSEA ≤ .08, CFI ≥ .95, and TLI ≥ .90 (Schreiber, Nora, Stage, Barlow, & King, 2006), although it is worth noting that in large samples, χ^2 is likely to be significant and does not necessarily indicate poor fit. Residuals were examined to determine whether any covariances between indicators should be modeled. Indicators were dropped from the model where appropriate following standard model building procedures, depending on path model estimates, fit indices, and residuals. However, care was taken to avoid overfitting the model to the data.

Latent Variable Structural Equation Model Regressions. After establishing measurement structure, we assessed the effects of the two types of behaviors at Time 1 in predicting changes in socioemotional well-being from Time 1 to Time 2 using change scores of T2 minus T1 (see Fig. 1). To accomplish this, we integrated the final fitted measurement models obtained from model building into a regression framework examining positive health vs. prosocial behaviors as exogenous latent predictors of change in the manifest variables of depressive symptoms, anxiety symptoms, and loneliness over time, while also assessing possible covariances shared within and across manifest and latent variables. These regression analyses controlled for age, gender, and income (reported at Time 2) as covariates. For analyses also accounting for race/ethnicity, see Supplemental Material (Tables S3 and S4). We report standardized betas or β throughout these results, which serve as effect size estimates. Data and code to replicate analyses are posted on the Open Science Framework (see Data availability statement).

Results

Confirmatory Factor Analysis

Model-building occurred in two steps. The first model (Model 1), which included all manifest indicators, converged after 43 iterations with 745 observations. All manifest indicators

loaded onto their respective latent variables at $p < .0001$. Interestingly, the covariance between the two latent factors was nonsignificant ($cov = .05$, $SE = .05$, $p = .27$), suggesting that these two latent factors may be independent from one another. However, Model 1 demonstrated poor fit [$\chi^2 = 243.35$, $p < .0001$; RMSEA = .09, $p < .0001$; CFI = .87, TLI = .83]. Closer inspection of the residuals and modification indices revealed that although hand-washing loaded best onto the positive health behavior factor, it also loaded onto the prosocial behavior factor, and more generally did not fit well with other manifest items. As such, we dropped this behavior from the model. The modification indices also suggested that we should model two additional covariances: one between volunteering to help with food needs and volunteering to help with pharmacy needs and a second between thanking an essential worker and supporting local businesses.

After dropping hand-washing and adding in these two additional covariances, Model 2 converged upon 59 iterations with 745 observations and showed much improved, acceptable fit statistics [$\chi^2 = 86.44$, $p < .0001$; RMSEA = .06, $p = .123$; CFI = .96, TLI = .94]. All manifest indicators again loaded onto their respective latent variables at $p < .0001$. However, unlike in Model 1, the covariance between the two latent factors was significant ($cov = .25$, $SE = .08$, $p = .003$, with $r = .17$), suggesting that these two latent factors do indeed covary with one another. Examination of residuals and modification indices affirmed that the two separate—but covarying—latent factors provided an appropriate measurement structure to use (consistent with our *a priori* behavior selection and hypotheses), with no modification indices suggesting a need for cross-loadings. Thus, Model 2 was the final model we used as the basis of our latent variable regressions predicting changes in socioemotional well-being.

Latent Variable Regressions Predicting Change in Socioemotional Well-being

Using the measurement structure from Model 2 established above with the latent variable CFAs, we next fit a latent variable regression model with SEM in order to examine how the latent variables of positive health vs. prosocial behaviors might predict change in the

manifest outcome variables of depressive symptoms, anxiety symptoms, and loneliness over time during the COVID-19 pandemic (Table 1; Fig. 1). We also controlled for the covariates of age, sex, and income (reported at Time 2), included as exogenous manifest predictors of the outcomes.

The model converged after 190 iterations with all 745 observations and showed adequate model fit [χ^2 = 223.98, p < .0001; RMSEA = .05, p = .24; CFI = .92, TLI = .89]. For the latent variable predictors, all manifest indicators again loaded well onto their respective latent factors (ps < .0001) and there were no concerning modification indices. There remained a significant covariance between the two latent factors (cov= .25, SE=.08, p=.002 with r = .17). There was also significant covariance between volunteering to help with food needs and volunteering to help with pharmacy needs (cov= 2.76, SE=.29, p<.0001 with r = .55) and between thanking an essential worker and supporting local businesses (cov= 1.18, SE=.32, p<.0001 with r = .20). As can be seen in Table 1 and in line with hypotheses, greater endorsement of positive health behaviors at Time 1 predicted a significant decrease in depressive symptoms (β = -.66, SE = .27, p = .015) between Time 1 and Time 2, whereas greater endorsement of prosocial behaviors at Time 1 predicted a significant decrease in loneliness (β = -.53, SE = .25, p = .037) between Time 1 and Time 2. Neither kind of behavior predicted a change in anxiety symptoms.

As standardized betas can be interpreted as effect sizes comparable to Cohen's d or other standardized effect size metrics, results suggest that self-reports of positive health (β = -.66) and prosocial (β = -.53) behaviors may have a moderate effect size in predicting depressive symptoms and loneliness, respectively. Such effects are comparable to findings linking perceived social support with the same outcomes (with depressive symptoms r = -.41; with loneliness r = -.58; Cacioppo, Hawkley, & Thisted, 2010) and other positive health behaviors like physical activity with reduced depressive symptoms (d = -.69; Robertson, Robertson, Jepson, &

Maxwell, 2012) and mindfulness interventions with reduced loneliness (*d* = .44, Lindsay, Young, Brown, Smyth, & Creswell, 2019). There were no significant effects of any covariates.

Although we were interested in the magnitude of change over time and thus relied upon change scores herein, it is also valuable to examine how Time 2 well-being outcome effects persist when controlling for Time 1 levels of the same well-being measures. To this end, we re-ran the above models with Time 2 depressive symptoms, anxiety symptoms, and loneliness as the outcomes and Time 1 levels as covariates. Consistent with results from SEM regressions, greater endorsement of positive health behaviors at Time 1 was associated with less depressive symptoms at Time 2, even after adjusting for depressive symptoms at Time 1 (β = -.53, *SE* = .24, *p* = .029). Greater endorsement of prosocial behaviors at Time 1 was also associated with less loneliness at Time 2, after adding Time 1 levels of loneliness as a covariate (β = -.50, *SE* = .24, *p* = .036). Results are presented in the Supplementary Materials (Table S2).

Discussion

Prosocial behavior and positive health behavior have previously been related to socio-emotional well-being. The current findings add to those literatures to suggest that similar behaviors preserve socioemotional well-being, even in the face of a chronic psychological stressor, the 2020-2021 COVID-19 global pandemic. Indeed, we found that engagement in positive health behaviors framed by the CDC as those meant to protect the self and others (from a highly communicable, deadly disease) protected the individual psychologically over time. Positive health behaviors such as wearing a facemask or staying home were associated with less depressive symptoms over time. We also found that more overtly prosocial behaviors such as thanking an essential worker or volunteering were associated with less loneliness over time. With the current data, we cannot disambiguate the extent to which participants engaged in positive health or prosocial behaviors for prosocial, selfish, altruistic, or mixed motivations. However, recent work highlights that individuals with high prosocial motivations, even up to two years prior, were more likely to engage in the positive health behaviors of facemask wearing

and distancing recommendations during the COVID-19 pandemic (Campos-Mercade, Meier, Schneider, & Wengstrom, 2021; Nelson-Coffey, O'Brien, Braunstein, Mickelson, & Ha, 2021), suggesting that prosocial motivations may promote positive health behaviors. Regardless of motivation, results serve as a reminder that, rather than incurring costs to the self, acting prosocially can benefit the self and protect against loneliness, while engaging in positive health behaviors can protect against depression during times of chronic stress.

There are a few points about the present sample demographics worth nothing. First, although we aimed to recruit across adulthood, this sample ended up including a sizable portion of older adults (M_{age} = 62.8 years). Although this older average age is consistent with other research on prosocial behavior and health (e.g., Brown et al., 2008; Roth et al., 2009; Sneed & Cohen, 2013), and we included age as a covariate to adjust for this sample characteristic, future research with other age groups would increase the generalizability of the current results. Similarly, relative to the typical U.S. demographics in the 2019 U.S. Census (United States Census Bureau, 2019) more participants identified as Asian/Asian American, Native Hawaiian/Other Pacific Islander, and Mixed Race, and fewer participants identified as Black/African American, White, American Indian or Alaska Native, and Hispanic/Latino than is typically representative of the U.S. population. It may be tempting to conclude that the present findings could be driven by the higher prevalence of Asian/Asian Americans in the current sample, given suggestions that this cultural group might be more collectivistic than non-Asian Americans and thus might derive more benefit from prosocial behaviors (Markus & Kitayama, 1991, though see Oyserman, Coon, & Kemmelmeier, 2002 for an updated perspective). However, cultural orientation was not measured in the current study and cannot be inferred based on demographics alone (Irizarry & Cohen, 2019; VanderWeele & Robinson, 2014). Thus, we are hesitant to draw conclusions about how the racial makeup of our sample may have influenced effects. Regardless, future replication in a nationally representative sample and in other nations and cultures beyond the U.S. is needed.

Though findings are correlational, inferences regarding the causal effect of positive health and prosocial behaviors on socioemotional well-being are strengthened by the longitudinal design. To further establish causality, future research could manipulate positive health and prosocial behaviors during chronic stress, track positive health and prosocial behaviors and socioemotional wellbeing longitudinally with experience sampling, and quantify the frequency and objective magnitude of positive health and prosocial behavior. Such designs might also overcome the limits of subjective self-report measures as used in the current design. Finally, it remains unclear why neither type of behavior predicted anxiety symptoms. One possibility is that the coinciding U.S. 2020 sociopolitical climate may have kept anxiety high overall, reducing the efficaciousness of positive health and prosocial behaviors on anxiety symptoms specifically. Future experimental research evaluating the effects of positive health or prosocial behavior on anxiety would bring greater clarity to this hypothesis.

In conclusion, these results advance current research on the benefits of prosocial behavior and positive health behavior to suggest that even amidst an ongoing, chronic stressor, behaving in ways that may help others can help everyone, even ourselves.

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Informed Consent: All participants provided electronic consent prior to survey completion.

Availability of data and material: Data are posted on the Open Science Framework at https://osf.io/hcbu3/?view_only=cafcb644edf443f395760b1551ad365e.

Code availability: Code is available on the Open Science Framework at the above link.

Author Contributions: TKI and KAM conceived of and designed the study. JKM analyzed the data with some additional analyses by TKI. TKI, KAM, and JKM wrote the manuscript.

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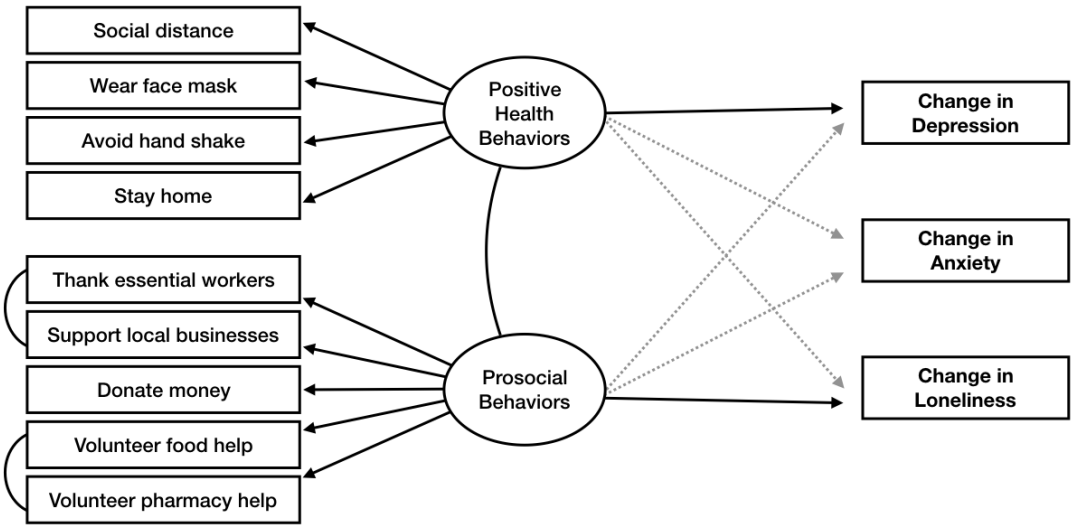
Table 1. Final structural equation regression model with the latent variables of positive health and prosocial behavior predicting change over time in depressive symptoms, anxiety symptoms, and loneliness during the COVID-19 pandemic in 2020.

Predictors	***β***	***S.E.***	***p***
Outcome: Change in Depressive Symptoms			
Positive health behaviors	**-0.66**	**0.274**	**.015**
Prosocial behaviors	-0.16	0.245	.527
Age	-0.03	0.020	.091
Sex	0.43	0.512	.397
Income	-0.16	0.165	.327
Outcome: Change in Anxiety Symptoms			
Positive health behaviors	-0.17	0.262	.508
Prosocial behaviors	-0.11	0.236	.655
Age	-0.01	0.020	.629
Sex	0.02	0.493	.965
Income	0.08	0.159	.629
Outcome: Change in Loneliness			
Positive health behaviors	0.08	0.275	.783
Prosocial behaviors	**-0.53**	**0.254**	**.037**
Age	-0.03	0.021	.137
Sex	-0.12	0.517	.821
Income	-0.07	0.166	.695
Loadings onto Positive Health Behaviors Latent Variable			
Social distancing	1.00		
Wear face mask	1.13	0.090	<.0001
Avoid handshakes	0.82	0.061	<.0001
Stay home	0.95	0.074	<.0001
Loadings onto Prosocial Behaviors Latent Variable			
Thank essential workers	1.00		
Support local business	0.97	0.118	<.0001
Give donations	1.23	0.181	<.0001
Volunteer for food help	1.02	0.154	<.0001
Volunteer for pharmacy help	0.81	0.125	<.0001

Note: Significant effects in the structural equation regression paths are bolded. Outcomes represent change scores from T2 minus T1.

Figure 1. Structural equation regression model predicting change over time in depressive symptoms, anxiety symptoms, and loneliness.



Note. Significant paths are depicted in solid black and nonsignificant paths are depicted in dotted grey. Results control for age, sex, and income included as exogenous manifest predictors of the outcomes but are not depicted here. See Table 1 for all path effects; see main text for covariance effects.

Prosocial and positive health behaviors during a period of chronic stress protect socioemotional well-being

Tristen K. Inagaki, Jennifer K. MacCormack, & Keely A. Muscatell

Supplementary Materials

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Supplemental Measures

Perceived Effectiveness of Behaviors

Perceived effectiveness at helping others and the self was assessed for each behavior endorsed (on a 1 – “ineffective” to 9 – “very effective” – scale). Perceived effectiveness items were presented in randomized order. For the positive health behaviors, participants were asked how effective they thought each behavior was for: preventing the spread of the coronavirus to your loved ones; preventing the spread of the coronavirus to others; helping others who are particularly vulnerable; helping your loved ones who are particularly vulnerable. For the prosocial behaviors, participants were asked how effective they thought each behavior was for: helping your loved ones; helping others in general.

Given the CDC’s description of the positive health behaviors as protecting both others and the self, participants were also asked how effective these behaviors were at protecting the self. Therefore, participants reported on how effective the positive health behaviors were for: keeping you from getting the coronavirus; helping yourself. A parallel question was asked for the prosocial behaviors (i.e., how effective was the behavior at helping yourself?). If a participant reported not engaging in the behavior at all (e.g., a 1 on the 1 – 9 scale regarding extent of engagement), perceptions of effectiveness were not assessed for that behavior.

Supplemental Results

Perceived Effectiveness

Positive health behaviors were perceived as equally helpful for others (M = 7.59, SD = 1.58) and the self (M = 7.60, SD = 1.60, $t(707)$ = .27, p = .80, BCa 95% CI = [-.05, .04]). Prosocial behaviors were rated as more effective for helping others (M = 5.73, SD = 2.07) than the self (M = 5.35, SD = 2.34, $t(707)$ = 9.54, p < .001, BCa 95% CI = [.30, .45]).

Sensitivity Analyses with Race

We conducted secondary sensitivity analyses with a dummy coded categorical variable representing participant self-reported race. This categorical variable was coded 1 = White, 2 = Other (this included mixed race, American Indian, Pacific Islander, etc., which were very few), 3 = African/Black American, and 4 = Asian or Asian American.

For these analyses, we re-ran two structural equation models following the exact same specifications and set-up as in other analyses. In both models, we modeled positive health behaviors as a latent factor (loadings: social distancing, wearing face masks, avoiding handshakes, and staying home) and prosocial acts as a second latent factor (loadings: thanking essential workers, supporting local businesses, giving donations, volunteering for food help, volunteering for pharmacy help). Both models also included the previously included covariates of Age, Sex, and Income, plus the Race variable. Sensitivity Model 1 replicated our model reported in the main text focused on change between Time 2 – Time 1 for depressive symptoms, anxiety symptoms, and loneliness. Sensitivity Model 2 replicated our model reported here in the Supplementary where the outcomes were Time 2 depressive symptoms, anxiety symptoms, and loneliness, and Time 1 measures of those outcomes were included as covariates.

Model results remained consistent regardless of the inclusion of race as a covariate. See Table S2 and Table S3 for model effects.

Supplemental Discussion

As reported in Table S1, differences between participants who completed the Time 1 and Time 2 surveys and participants who only completed the Time 1 survey emerged for prosocial behavior, depressive symptoms, anxiety symptoms, and loneliness. Specifically, those who completed Time 1 and 2 surveys reported less prosocial behavior than those who only completed Time 1, and less depressive symptoms, anxiety symptoms, and loneliness. Although some sample attrition is typical of longitudinal survey studies, the unusual retention strategy enforced by Qualtrics (i.e., closing of the Time 2 survey based on sample size rather than allowing responses to come in or actively recruiting Time 1 participants to complete the Time 2 survey) makes interpretation of these differences difficult. In other words, the completion of the Time 2 survey may have more to do with the availability of the participant to quickly complete a survey than with the well-being of respondents. Importantly, results reported in the main text are only from participants who completed both Time 1 and Time 2 surveys and the descriptives on behaviors and socioemotional well-being outcomes (SD's) suggest a comparable amount of variability to those who only completed the Time 1 survey. In other words, even if the two samples differ and selection effects are present, the large analytic sample size (n = 745) and high variability in the variables measured are sufficient to test hypotheses. However, replication in samples that are also under chronic stress beyond the relatively healthy sample in the current study is critical to understanding associations between positive health and prosocial behavior and socioemotional well-being.

Table S1

Comparing participants who completed both Time 1 and Time 2 of the survey to those who only completed the Time 1 survey on the main predictors (positive health behaviors, prosocial behavior) and outcomes (depressive symptoms, anxiety symptoms, loneliness) at Time 1

	Those who only completed Time 1 survey (*n* = 1704)		Those who completed both Time 1 and 2 surveys (*n* = 745)			
	M	*SD*	*M*	*SD*	*t*	BCa 95% CI
Positive Health Behavior	8.00	1.35	8.06	1.25	1.20	-.05, .19
Prosocial Behavior	4.14	1.95	3.95	1.82	2.29*	-.36, -.01
Depressive Symptoms	12.31	9.96	10.45	8.33	4.45**	-2.55, -1.19
Anxiety Symptoms	34.68	10.92	32.63	10.00	4.37**	-2.91, -1.15
Loneliness	39.33	11.54	38.23	11.39	2.18*	-2.10, -.04

Note. Data presented is only from those who remained in the dataset after accounting for the following exclusions: endorsement of a mental health condition at Time 1, a COVID-19 diagnosis at Time 1 or 2, and living with someone with a COVID-19 diagnosis at Time 1 or 2. SD = standard deviation, BCa = bias-corrected and accelerated bootstrap interval based on 1000 bootstrap samples, CI = confidence interval

*$p < .05$ and BCa 95% CI excluding 0

**$p < .01$ and BCa 95% CI excluding 0

Table S2. Structural equation regression model with the latent variables of behavior predicting Time 2 depressive symptoms, anxiety symptoms, and loneliness while controlling for Time 1 depressive symptoms, anxiety symptoms, and loneliness during the COVID-19 pandemic in 2020.

Predictors	*β*	*S.E.*	*p*
Outcome: Time 2 Depressive Symptoms			
Positive health behaviors	**-0.53**	**0.244**	**.029**
Prosocial behaviors	0.21	0.216	.324
Time 1 depressive symptoms	**0.57**	**0.024**	**<.0001**
Age	**-0.08**	**0.018**	**<.0001**
Sex	0.10	0.457	.929
Income	**-0.32**	**0.147**	**.030**
Outcome: Time 2 Anxiety Symptoms			
Positive health behaviors	-0.22	0.243	.356
Prosocial behaviors	-0.06	0.215	.778
Time 1 anxiety symptoms	**0.64**	**0.020**	**<.0001**
Age	**-0.10**	**0.019**	**<.0001**
Sex	-0.17	0.456	.713
Income	**-0.32**	**0.147**	**.032**
Outcome: Time 2 Loneliness			
Positive health behaviors	0.02	0.260	.939
Prosocial behaviors	**-0.50**	**0.236**	**.036**
Time 1 loneliness	**0.72**	**0.019**	**<.0001**
Age	**-0.08**	**0.020**	**<.0001**
Sex	-0.04	0.489	.938
Income	**-0.35**	**0.158**	**.028**
Loadings onto Positive Health Behaviors Latent Variable			
Social distancing	1.00		
Wear face mask	1.13	0.090	<.0001
Avoid handshakes	0.82	0.061	<.0001
Stay home	0.95	0.074	<.0001
Loadings onto Prosocial Behaviors Latent Variable			
Thank essential workers	1.00		
Support local business	0.98	0.117	<.0001
Give donations	1.19	0.175	<.0001
Volunteer for food help	0.99	0.149	<.0001
Volunteer for pharmacy help	0.78	0.121	<.0001

Note: Significant effects in the structural equation regression paths are bolded.

Table S3. Structural equation regression model with the latent variables of behavior predicting change in depressive symptoms, anxiety symptoms, and loneliness while adjusting for age, sex, race, and income.

Predictors	*β*	*S.E.*	*p*
Outcome: Change in Depressive Symptoms			
Positive health behaviors	**-0.70**	**0.275**	**.010**
Prosocial behaviors	-0.16	0.246	.520
Age	-0.03	0.022	.266
Sex	0.39	0.512	.449
Race	0.25	0.219	.255
Income	-0.16	0.164	.330
Outcome: Change in Anxiety Symptoms			
Positive health behaviors	-0.15	0.262	.567
Prosocial behaviors	-0.11	0.236	.657
Age	-0.02	0.021	.461
Sex	0.05	0.493	.920
Race	-0.16	0.211	.460
Income	-0.08	0.158	.625
Outcome: Change in Loneliness			
Positive health behaviors	0.05	0.275	.852
Prosocial behaviors	**-0.53**	**0.255**	**.036**
Age	-0.02	0.022	.276
Sex	-0.15	0.517	.777
Race	0.16	0.221	.464
Income	-0.06	0.166	.699
Loadings onto Positive Health Behaviors Latent Variable			
Social distancing	1.00		
Wear face mask	1.13	0.090	<.0001
Avoid handshakes	0.82	0.061	<.0001
Stay home	0.95	0.074	<.0001
Loadings onto Prosocial Behaviors Latent Variable			
Thank essential workers	1.00		
Support local business	0.97	0.118	<.0001
Give donations	1.23	0.182	<.0001
Volunteer for food help	1.02	0.154	<.0001
Volunteer for pharmacy help	0.81	0.125	<.0001

Note: Significant effects in the structural equation regression paths are bolded.

Table S4. Structural equation regression model with the latent variables of behavior predicting Time 2 depressive symptoms, anxiety symptoms, and loneliness while controlling for Time 1 depressive symptoms, anxiety symptoms, and loneliness while adjusting for age, sex, race, and income.

Predictors	*β*	*S.E.*	*p*
Outcome: Time 2 Depressive Symptoms			
Positive health behaviors	**-0.59**	**0.244**	**.016**
Prosocial behaviors	0.21	0.216	.326
Time 1 depressive symptoms	**0.57**	**0.024**	**<.0001**
Age	**-0.06**	**0.020**	**<.0001**
Sex	0.03	0.457	.942
Race	0.36	0.195	.067
Income	**-0.32**	**0.147**	**.030**
Outcome: Time 2 Anxiety Symptoms			
Positive health behaviors	-0.24	0.242	.322
Prosocial behaviors	-0.06	0.215	.782
Time 1 anxiety symptoms	**0.64**	**0.020**	**<.0001**
Age	**-0.10**	**0.019**	**<.0001**
Sex	-0.19	0.457	.682
Race	0.11	0.196	.578
Income	**-0.32**	**0.147**	**.032**
Outcome: Time 2 Loneliness			
Positive health behaviors	-0.03	0.260	.906
Prosocial behaviors	**-0.50**	**0.236**	**.035**
Time 1 loneliness	**0.72**	**0.019**	**<.0001**
Age	**-0.07**	**0.021**	**.001**
Sex	-0.10	0.489	.841
Race	0.32	0.210	.113
Income	**-0.35**	**0.158**	**.028**
Loadings onto Positive Health Behaviors Latent Variable			
Social distancing	1.00		
Wear face mask	1.13	0.090	<.0001
Avoid handshakes	0.82	0.061	<.0001
Stay home	0.95	0.074	<.0001
Loadings onto Prosocial Behaviors Latent Variable			
Thank essential workers	1.00		
Support local business	0.98	0.117	<.0001
Give donations	1.19	0.175	<.0001
Volunteer for food help	0.99	0.149	<.0001
Volunteer for pharmacy help	0.78	0.121	<.0001

Note: Significant effects in the structural equation regression paths are bolded.